

WHAT IS CLAIMED IS:

1. A process for producing fumed metal oxide particles comprising:
 - (a) providing a stream of a liquid feedstock comprising a volatizable non-halogenated metal oxide precursor;
 - (b) providing a stream of a combustion gas having a linear velocity sufficient to atomize and combust or pyrolyze the liquid feedstock;
 - (c) injecting the stream of the liquid feedstock into the stream of combustion gas to form a reaction mixture such that the liquid feedstock is atomized and subjected to a sufficient temperature and residence time in the combustion gas stream for fumed metal oxide particles to form before the combustion gas temperature is reduced below the solidifying temperature of the fumed metal oxide particle.
2. The process of claim 1 further comprising quenching the reaction mixture..
3. The process of claim 2, wherein the reaction mixture is quenched by air.
4. The process of claim 2, wherein the reaction mixture is quenched by steam.
5. The process of claim 2, wherein the reaction mixture is quenched by water.
6. The process of claim 2, wherein the stream of the liquid feedstock is injected into the stream of combustion gas inside a reactor having walls and the reaction mixture is quenched by heat transfer to the walls of the reactor.
7. The process of claim 1, wherein the metal oxide precursor is a silicone compound.
8. The process of claim 7, wherein the silicone compound is selected from the group consisting of silicates, silanes, polysiloxanes, cyclic polysiloxanes, silazanes, and mixtures thereof.
9. The process of claim 8, wherein the silicone compound is selected from the group consisting of tetraethoxyorthosilicate, tetramethoxyorthosilicate, tetramethoxysilane, tetraethoxysilane, methyltrimethoxysilane, methyltriethoxysilane, dimethyldimethoxysilane, dimethyldiethoxysilane, trimethylmethoxysilane, trimethylethoxysilane, diethylpropylethoxysilane, silicone oil, octamethylcyclotetrasiloxane,

decamethylcyclopentasiloxane, dodecamethylcyclohexasiloxane, hexamethylcyclotrisiloxane, hexamethyldisilazane, and mixtures thereof.

10. The process of claim 9, wherein the silicone compound is selected from the group consisting of methyltrimethoxysilane, octamethyltrimethoxysilane, and mixtures thereof.

11. The process of claim 1, wherein the metal oxide precursor is selected from the group consisting of aluminum(III) n-butoxide, aluminum(III) sec-butoxide, aluminum(III) isopropoxide, trimethylaluminum, and mixtures thereof.

12. The process of claim 1, wherein the liquid feedstock comprises a silicone compound and at least one compound selected from the group consisting of aluminum(III) n-butoxide, aluminum(III) sec-butoxide, aluminum(III) isopropoxide, and trimethylaluminum.

13. The process of claim 1, wherein the stream of combustion gases is established by combustion of a preheated oxidant stream and a liquid or gaseous fuel stream.

14. The process of claim 13, wherein the oxidant stream is selected from the group consisting of air, oxygen, and mixtures thereof.

15. The process of claim 13, wherein the fuel stream comprises a hydrocarbon.

16. The process of claim 15, wherein the hydrocarbon fuel stream is selected from the group consisting of natural gas, methane, acetylene, alcohol, kerosene, and mixtures thereof.

17. The process of claim 13, wherein the fuel stream comprises hydrogen.

18. The process of claim 1, wherein the stream of the liquid feedstock is injected into the stream of combustion gas through at least one nozzle.

19. The process of claim 18, wherein the nozzle is a single fluid nozzle.

20. The process of claim 18, wherein the nozzle is a bi-fluid nozzle.

21. The process of claim 18, wherein the liquid feedstock is injected into the stream of combustion gas through two or more nozzles.

22. The process of claim 21, wherein at least one of the nozzles is located downstream of the other nozzle.

23. The process of claim 1, wherein the metal oxide particles are formed by pyrolysis.

24. The process of claim 23, wherein the reaction mixture is contacted with CO₂ or H₂O to increase oxidation prior to the reduction of the combustion gas temperature below the solidifying temperature of the fumed metal oxide particle.

25. A composition comprising about 2000 or more fumed silica aggregates having a primary particle size d and an aggregate size D_{circ} , wherein the average of the primary particle sizes d_{ave} , the average of the aggregate sizes $D_{circ\ ave}$, and the geometric standard derivation of the aggregate sizes $\sigma_g(D_{circ})$ satisfy one or both of the following equations:

$$(1) \quad D_{circ\ ave} (\text{nm}) < 52 + 2 \times d_{ave} (\text{nm})$$

$$(2) \quad \sigma_g(D_{circ}) < 1.44 + 0.011 \times d_{ave} (\text{nm}).$$

26. The composition of claim 25, wherein the fumed silica particles have a surface area, and the primary particle size d is calculated from the surface area SA according to the following equation:

$$d (\text{nm}) = 1941/SA (\text{m}^2/\text{g}).$$

27. The composition of claim 26, wherein equation (1) is satisfied.

28. The composition of claim 26, wherein equation (2) is satisfied.

29. The composition of claim 26, wherein both equations (1) and (2) are satisfied.

30. The composition of claim 25, wherein the composition comprises about 5000 or more fumed silica aggregates.